ECS188 – Genetically Modified Foods: Is it good or bad?

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Abstract

In this paper, we will examine in detail some of the benefits and harms of genetically modified foods (GM Foods). Although genetic engineering in foods can be a solution to many of the problems in society today, its potentials are often overlooked due to overpowering voices from non-supporting groups. Some of these concerns, we claim, are a result of disagreeing opinions between GM food producers and consumers, as well as a lack of knowledge to this seemingly new technology. We suggest, in order to have a better understanding of the effects of GM foods (both positive and negative), the government should intervene with greater authority than it currently does.

Problem: Conflicting Perspectives and the Government

There exist two different viewpoints when considering the topic of genetically modified foods (GM foods). The first is that genetic modification is "simply an extension of plant-breeding methods".[1] The second viewpoint is the exact opposite, stating that genetic modification is "radically different" from the traditional plant-breeding method; it is "a special case that requires special treatment".[2] In other words, GM foods utilize methods that are incomparable to those of traditional breeding; no equivalence can be established between the outputs of these entirely different methods. In truth, both of these view points are valid, but are perspectives from two different parties. The former is that of large industries, where as the latter is that of consumers. These seemingly conflicting viewpoints have led to biased measurements toward evaluating the benefits and harms of GM foods. For example, a large industry may view a genetically altered pesticide resistant crop as a benefit to the environment by reducing pesticide usage. But at the same time, consumers may claim the pesticide resistant crop is actually a harm to human health, because it may contain toxins. Therefore, the first step to fully realize the potential of GM foods is to bridge the differences between these seemingly polar perspectives. The government is the best mediator between the industry and consumers to present a more unified outlook on GM foods. Currently, with the help of governmental regulation and funded research, genetic modification in crops has shown many benefits that has the potential to positively change society. However, despite these findings, the current public opinion towards GM foods remains generally negative. Why do the cons outshine the pros? Examination of the problems that are created by GM foods reveal that such problems mainly exist due to the lack of strict regulation and mandatory research of GM foods prior to their entering the market. In order to realize the full potential and long term effects of GM foods, the government must take full charge of all processes in developing GM foods, including research and regulation.

An Examination of the Benefits in GM Foods

There are many benefits in genetically modified foods, such as improving the health of crops, increasing their nutrition content, and elongating their shelf life. Though there are many other benefits that will not be mentioned here, an in depth examination of these three will show that GM foods can indeed bring about a beneficial change to societies at the global level.

(1) Save the Economy

One of the earlier purposes of genetic modification in foods was to improve the health of crops, as with the case of the papaya crisis in Hawaii in the early 1990's. Papaya, the second largest fruit crop of Hawaii, yielding an annual production worth $17 million[3], was attacked by the ringspot virus. As a result, the state was devastated when this epidemic threatened to destroy the state's papaya industry. "By 1994, nearly half the state's papaya acreage had been infected, their owners forced to seek outside employment".[4] The papaya industry didn't stand a chance against the virus. However, a Cornell University plant pathologist, Dennis Gonsalves, found a solution to the problem by creating "a virus-resistant transgenic papaya".[5] After extensive field trials, the transgenic papaya was declared a success in 1996. Soon after "the papaya growers switched en masse to the transgenic seeds and reclaimed their orchards".[6] Genetic modification not only saved the papayas, but it also saved Hawaii's papaya industry, and thus a major part of the state's economy.

(2) Cure for Malnutrition and World Hunger

In addition to improving the health of a crop, genetic modification also has the ability to improve a crop's quality and nutritional content. A great example is the genetically modified rice, "golden rice". Golden rice was created by Ingo Potrykus and "his chief collaborator, Peter Beyer of the University of Freiburg in Germany" in the spring of 1999.[7] Golden rice has a slight yellow tint due to the added beta-carotene, the nutrient that serves as a building block for vitamin-A. Each year at least one million children die "because they are weakened by vitamin-A deficiency and an additional 350,000" go blind.[8] Potrykus wanted to improve rice's nutritional content because "he knew that of some 3 billion people who depend on rice as their major staple, around 10% risk some degree of vitamin-A deficiency and the health problems that result".[9] He wanted to provide a solution to malnutrition in poor countries. Potrykus' golden rice has recently been improved to contain more nutritional value than the original. Syngenta, a seed producer and one of the companies that aided in the invention of golden rice, has continued Potrykus' dream to fight mal-nutrition in third world countries. Syngenta's golden rice "has recently been improved as the "Golden Rice 2", now containing 23 times as much beta carotene as the original. Scientists testing the strain say that a serving of 200 grams should provide the recommended daily Vitamin A intake".[10] By improving the nutritional content of rice, a staple food for many, golden rice can help improve the health of the world's population. In the same way, genetic modification in other crops can become one of the many solutions to world hunger and malnutrition.

(C) Improve Consumer Experience

Another benefit to genetic modification in foods is to increase shelf live, therefore allowing consumers to enjoy food products more often and for a longer period of time. Many produce are difficult to manage due to their short shelf live, such is the case with tomatoes:

> Tomatoes don't travel well; to transport them cross-country, producers pick them while they are still green. To make matters worse, tomato middlemen often store the green tomatoes for weeks in refrigerator trucks, holding out for the best price. Then, just before they are sold, the tomatoes are gassed with ethylene to make them red.[11]

Calgene, a company based in Davis, California tried to solve this problem by introducing Flavr Savr tomatoes to the US market in May 1994.[12] In these tomatoes, scientists silenced the gene

that causes tomatoes to rot, thus causing them to stay fresher longer.[13] This would allow for tomatoes to be "picked ripe, transported and stored for up to 10 days, providing plenty of time for shipping and sale".[14] By increasing the life time of products, genetic modification also increases their availability. Now consumers can enjoy food products that are off season and produce that could stay fresh longer.

An Examination of the Harms in GM Foods

Despite the fact that genetic modification has the potential to save a crop from destruction, solve world hunger and malnutrition issues, and improve consumer experience with food products, there still are many concerns that cannot be neglected. Some of the concerns regarding GM foods fall into one of the following categories: safety issues, impact on the environment, and whether or not GM crop dispersion is controllable.

(1) Human Health Issues: Allergens

The existence of allergens in GM foods is one of the major concerns regarding the safety of GM foods. The question of whether GM foods will create any new allergies or diseases that were not present in the non-GM version cannot be answered with much certainty. Furthermore, the chance of transferring one crop's allergen inducing genes to another during genetic modification is very probable. Both of these concerns are legitimate; past experiences and experiments with GM foods have proven that people have developed severe allergic reactions to usually non-allergenic foods.

Fear of new allergens in GM foods became a valid concern in 1989 during the EMS (eosinophilia-myalgia syndrome) epidemic in U.S., which caused several hundreds of people to experience severe symptoms such as:

> hardening of the skin, cognitive problems, headaches, extreme light sensitivity, and fatigue and heart problems. The worst cases were crippled by 'ascending paralysis, in which a person loses nerve control of the feet followed by the legs, then bowels and lungs, finally requiring a respirator in order to breathe'.[15]

Doctors were baffled as to what could have caused such ailments. Finally the culprit was narrowed down to the dietary supplement L-tryptophan. With further investigation, scientists were able to determine that a specific manufacturer of the L-tryptophan, Showa Denko KK from Japan, had caused this epidemic. The Showa Denko L-tryptophan showed higher levels of impurities than those produced by other manufacturers. Also, "to produce L-tryptophan, most of the Japanese manufacturers combined certain strains of bacteria and enzymes in a fermentation process…Showa Denko, however …genetically engineered their bacteria to dramatically increase yields".[16] As a result of these genetically altered bacteria, new allergens were created and introduced into the L-tryptophan supplement. Although a vast amount of research points to the genetic engineering as the cause of the epidemic, the FDA, after short-lived investigation, side stepped this argument and made no firm allegations against genetic engineering as being the cause to this epidemic.

The EMS epidemic is an example of how GM products resulted in new ailments and reactions. But there have been cases where known allergens have been transmitted from one crop to another. A specific example is Pioneer Hi-Bred's modified soybean. In order to increase the

nutritional value of soybeans, Pioneer Hi-Bred inserted a gene from Brazil nuts into soybeans. A new amino acid had been successfully added to the soybean, "However, the process also transferred a major food allergen from nuts to soybeans, causing them to invoke similar allergic reactions to the brazil nuts themselves".[17] Thus for those who are allergic to Brazil nuts, consumption of such soybeans could be lethal. In response to such cases, in 1992 the FDA stated that "foods must be tested and labeled for allergy sensitivity if they have been created using DNA from any foods known to cause an allergic reaction".[18] Such regulation does provide protection from cases such as the one mentioned above, but there is a shortcoming to this as well. This ruling "does not apply to most genetically modified foods. Crops modified with genes from bacteria, for example, are not required to be tested for allergens under the FDA ruling".[19] The loop holes in such regulation, together with the unpredictable nature of genetic engineering, cause the transference of allergens between organisms to be a possibility. Therefore, consumption of GM foods may invoke new or unexpected allergic reactions that could endanger one's life. As a food safety concern, more research regarding allergens is necessary to minimize health risks.

(2) Environmental Damages

Another concern closely linked to human and animal safety is the impact that GM foods have on the environment and wildlife, whether directly or indirectly. Industries claim that genetically modified herbicide-resistant plants "will help the environment by reducing toxic herbicide/pesticide use".[20] Though this may be true in some cases, the overall situation is quite the opposite. The companies that create herbicide-resistant and pesticide-resistant GM crops are also the ones that sell herbicides and pesticides in the first place; their "primary intent is to sell more, not less of their products".[21] Since the crops are not harmed by the herbicides/pesticides, more and more herbicides/pesticides are being used. "R.J. Goldburg scientists predict herbicide use will triple as a result of GM products".[22] The environmental impact of increasing such toxins will lead to "increased contamination of our water supply and food" as well as creating "herbicide-resistant weeds".[23] GM crops can also have an impact on wildlife. In 1999 the science journal *Nature* published an article stating that "the pollen from Bt corn was toxic to the monarch butterfly…many larvae died when they ate their favorite milkweed leaves upon which Bt pollen had been dusted".[24] GM crops' impact on the environment not only affects our own health and welfare but it also damages wildlife.

(3) Uncontrollable Gene Pollution

On top of issues regarding the impact that GM foods have on the welfare of humans and the environment, an emerging concern is about whether its dispersion is controllable or not. The ability to control GM crops and organisms is not very feasible as of yet, and thus contamination or rather "gene pollution" is a major concern for businesses and farmers. For example, cross pollination is a method by which genetically engineered traits are dispersed among crops within close proximity of one another. Such distribution is completely out of human control and can lead to the growing of GM crops in fields that were specifically designated for non-GM crops. This uncontrollable dispersion can create unexpected health problems as well as economic problems for those companies and individuals who are unknowingly selling their contaminated products.

In September of 1999, reports from an independent tester found that the corn chips produced by Terra Prima "contained traces of genetically modified corn" even though Terra Prima is "a certified organic producer".[25] "The company chose to destroy 87,000 bags of their corn chips and essentially swallow $147,000 when they couldn't sell their product as organic".[26] Interestingly, the farmer who had sold them the corn did not use any GM seed varieties to grow the corn. This unanticipated contamination occurred from "pollen from GM corn that was blown over from another farm and whose patented gene was the same one picked up in the test".[27] Not only did this occurrence drastically affect the financial situation of this small company, but it also raised concerns for similar organizations that feared their "organic" products might indeed become contaminated by GM crops in nearby fields.

Weak Governmental Intervention

The adverse impacts of GM foods that cause us to question our human, environmental, and economic safety are a result of inadequate regulation and weak legislation. The Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the Animal and Plant Health Inspection Service (APHIS) are the three main agencies involved in ensuring the safety and quality of GM foods in US. But due to their loose regulation, these US agencies are falling behind the European Union (EU) in their effectiveness to ensure GM food safety and quality. For example, the following table shows the differences between EU and US GMO product approval and labeling procedures:

[28]

	EU	USA
Public opinions broadly consulted (as for example in labeling requirements)	Yes	Partly
Testing for environmental effects completed before market introduction, completed before marketing approval	Yes	No (can be done after introduction)
10 year limit on market approval	Yes	No
Broad environmental sustainability issues considered during risk assessment	Yes	Partly
Product traceability requirements	Yes	No
Case-by-case approach	Yes	No (trait based)
Post-marketing monitoring of environmental effect	Yes	No
Use of substantial equivalence	No	Yes

In the US, the "regulatory framework is based on the assumption that GM products do not pose risks different to those from similar, conventional products… new specific regulations were deemed unnecessary, and the overall approach is product-based, not process-based like in the EU".[29] Stricter regulation and proper mandatory research may have allowed for the EMS epidemic of 1989 to be avoided. This, however, does not imply that the European Union is advanced in their ability to minimize concerns regarding GM foods. It merely shows that the EU is somewhat ahead of the US in its mission to ensure that GM foods are safe and beneficial to the human society, environment, and the economy.

Is GM Foods Good or Bad: The Answer is Relatively Unknown

Though Genetically Modified Foods do bring about a range of never before encountered problems, however, one should not forget the occurrences where genetic engineering was the only solution to devastating problems. Genetic engineering saved the papaya crop and Hawaii's economy. And if it were not for genetic engineering, nutritional contents could not have been added into the golden rice kernel, but only to the shells, which brings no nutritional value to the human diet. Like every new technology, GM foods have their pros and cons. But due to lack of proper regulation and intensive research of GM foods prior to launching them into the market, consumers tend to shine away from them. GM foods have a great potential, but that potential can only be realized once a greater understanding of this new technology has been established. With the same argument, the negative effects of GM foods still need to be researched thoroughly. The public needs to be educated in order to make an objective judgment to whether GM foods are good or bad. And the best candidate for such mission is a more effective government that leads unbiased research and development, and intensive regulation to ensure that both the industry and consumers have a better understanding of the long term effects of Genetically Modified Foods.

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